MEMORANDUM

August 8, 2000

TO: Carol Nielsen (UDAQ), via e-mail   STI Ref. No. 999681

FROM: Dana Coe

SUBJECT: Silt loading factors for the Salt Lake Regional PM_{10} inventory.

I have revisited the following sources of information regarding silt loading factors for the Salt Lake Region.

- UDAQ's input and output files for the U.S. Environmental Protection Agency's Highway Vehicle Particulate Emission Modeling Software (PART5), dated October 27, 1999.

- U.S. Environmental Protection Agency (1997) Compilation of Air Pollutant Emission Factors, AP-42, Fifth Edition, Volume I: Stationary Point and Area Sources. Section 13.2.1 - Paved Roads (in Supplement D). EPA report nos. EPA-454/F-99-003 and AP-42-ED-5. Downloaded on June 26, 2000 from http://www.epa.gov/ttn/chief/ap42c13.html.

- Midwest Research Institute (1993) Emission Factor Documentation for AP-42, Section 13.2.1 – Paved Roads (with Microsoft Excel databases newsldat.xls and oldsldat.xls). Report and databases prepared for the Emission Factors and Inventory Group of the Office of Air Quality Planning and Standards at the U.S. Environmental Protection Agency under EPA Contract No. 68-D0-0123 Work Assignment No. 44, March 8. Downloaded on June 26, 2000 from http://www.epa.gov/ttn/chief/ap42c13.html.

- AeroVironment, Inc. (1992) Salt Lake County roaddust silt loading winter 1991/92 measurement program: post-storm measurement results. Report prepared by AeroVironment, Inc. for the Utah Department of Environmental Health/Division of Air Quality, June 5.

While I was reviewing these references, I encountered a few confusing issues. Four future reference, I have documented here the likely causes for confusion.

- UDAQ's PART5 modeling inputs seem to include silt loading factors from the Midwest Research Institute (MRI) database. The MRI database cites the 1992 AeroVironment report and includes five silt loading factors for Salt Lake City, which apply to the following five facility types: Interstate Freeway 80 (I-80), I-15, arterials, collectors, and local roads. UDAQ's PART5 modeling inputs (which differ between Davis, Salt Lake, and Utah Counties) include three facility classes: freeways, arterials, and local roads. I believe that the differences in the input files exist because the silt loading factors for arterials and local roads were assigned inconsistently. For example, for Davis and Utah

Counties the MRI silt loading factor for collectors was assigned to arterial roads. However, for Salt Lake County the MRI silt loading factor for arterial roads was assigned to arterial roads. **Table 1** illustrates the apparent silt loading factor assignments for Davis, Salt Lake, and Utah Counties that were used for PART5 modeling purposes.

- During my review of the AeroVironment report, I recalculated the average observed silt loading factors. I found that the data table omitted the data points from the pre-storm sampling program for three of the four facility classes (freeways, arterials, and collectors). Therefore, I was unable to verify some of the calculated results.

- The definitions of arterials, collectors, and local roads seem to overlap between the AeroVironment (1997) reference, the EPA (1997) reference, and/or UDAQ PART5 inputs.

- The MRI database and the AeroVironment report seem to include some typographical errors and/or miscalculations, which are documented by footnotes C-F in **Table 2**.

Table 2 tabulates the silt loading factors cited in the reviewed references. The last line of Table 2 contains the silt loading factors that I recommend for use in the Salt Lake Regional PM_{10} emission inventory. In order to apply these emission factors, it will be necessary to either (1) run the PART5 model for four facility classes, or (2) estimate representative VMT-weighted silt loading factors that account for the roads classified as collectors by the AeroVironment (1992) report. The equations below illustrate how to calculate VMT-weighted silt loading factors.[*]

$$SL_{PART5,arterial} = 0.137 \times VMT_{AV,arterial} + 0.288 \times (VMT_{UDAQ,arterial \cap AV,collector})$$

$$SL_{PART5,local} = 0.683 \times VMT_{AV,local} + 0.288 \times (VMT_{UDAQ,local \cap AV,collector})$$

where:

SL_{PART5} = Silt loading factor for use in PART5 modeling

VMT_{AV} = Vehicle-miles traveled by facility class, where facility classes are defined as suggested in the AeroVironment (1992) report.

VMT_{UDAQ} = Vehicle-miles traveled by facility class, where facility classes are defined consistently with UDAQ's previous PART5 modeling runs.

Table 1. Silt loading factor assignments for previous PART5 model runs.

	UDAQ Facility Class	Silt Loading Factor used in PART5	MRI Facility Class (corresponding to the silt

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[*] Note: $\cap$ is a mathematical operator indicating "intersection of independent sets." As applied here, it indicates those facilities with variable class definitions differ. The intersection "UDAQ,local $\cap$ AV,collector" includes those facilities that are defined as local roadways in UDAQ's previous PART5 modeling runs, but are defined as collectors in the AeroVironment (1992) report.

County	(for PART5)	(g/m²)	loading factor)
Davis and Utah	Freeways	0.1 (rounded to tenths)	Freeways
	Arterials	0.29	Collectors
	Local	1.97	Local
Salt Lake	Freeways	0.06 (rounded to hundredths)	Freeways
	Arterials	0.14	Arterials
	Local	0.29	Collectors

Table 2.   Silt loading factors cited in various references.

	Silt Loading Factor (g/m²)			
Source of Information	Freeways	Arterial Roads	Collectors	Local Roads
EPA (1997); national default values	0.2 freeways	0.5 high ADT, 5000+ vehicles	3 low ADT, <5000 vehicles	
UDAQ PART5 inputs Davis and Utah Counties[A]	0.1	0.29	1.97	
Salt Lake County[B]	0.06	0.14	0.29	
Midwest Research Institute (1993); database entries for SLC	0.060[C] 0.096; I-15 0.023[E]; I-80	0.137 700 East	0.288 State St.	1.967[D] 400 East
Aerovironment (1992); SLC pre-storm	0.124; avg 0.074; I-15 0.175; I-80	0.280 700 East	0.906 State Street	3.042 400 East
post-storm	0.050[F]; avg 0.096; I-15 0.022; I-80	0.137 700 East	0.288 State Street	0.683 400 East
Recommended	**0.059**	**0.137**	**0.288**	**0.683**

ADT = automated daily traffic count (observed by an automatic traffic counter), number of vehicles per day; SLC = Salt Lake City; avg = average

[A] Silt loading factors are from the Midwest Research Institute database for the following facility types: freeway (rounded off to tenths), collector, and local. The factor for arterial roads was not used.

[B] Silt loading factors are from the Midwest Research Institute database for the following facility types: freeway, arterial, and collector. The factor for local roads was not used.

[C] Based on the average (0.23 + 0.96) ÷ 2. However, it should have been calculated as (0.22 + 0.96) ÷ 2 = 0.059 (see footnote E).

[D] This is a miscalculated average of the post-storm samples. The average included two re-vacuum samples (which were collected by re-vacuuming a previously sampled patch of roadway to determine the efficiency of the vacuum) and all of the pre-storm samples collected for local roads.

[E] Type-O. Should have been 0.022.

[F] Type-O or miscalculation. Should have been 0.059, or the average (0.22 + 0.96) ÷ 2 = 0.059.